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The Korean public's willingness to pay for expanding the use of solid refuse fuel

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ABSTRACT

Solid refuse fuel (SRF), a solid fuel that is produced from non-hazardous combustible waste, can mitigate greenhouse gas emissions compared with fossil fuels. The Korean Government plans to enhance the ratio of combustible waste converted into SRF from 16% in 2014 to 100% in 2020 by increasing the number of facilities that make and use SRF. This paper attempts to investigate empirically the Korean public's willingness to pay (WTP) for expanding the use of SRF. The WTP data were obtained from a one-and-one-half-bounded dichotomous choice contingent valuation survey of 1000 households. Because a considerable number of respondents (62.6%) gave a zero WTP response, we applied a spike model to treat the WTP data with zero observations. The spike model fitted the data well considering that all the coefficient estimates are statistically significant at the 1% level. The yearly mean WTP was computed as KRW 2479 (USD 2.17) per household for the next 10 years, which is also statistically meaningful at the 1% level. Expanding the value to the national population gives us KRW 46.4 billion (USD 40.5 million) per year. The present value of the total public WTP amounts to KRW 369.0 billion (USD 322.3 million) using a social discount rate of 5.5%. We can conclude that Korean households are ready to shoulder some of the financial burden to expand the use of SRF.

1. Introduction

The temperature of the Earth has increased as a result of greenhouse gas (GHG) emissions. Due to the global temperature rising by 0.85 °C, the world is experiencing starvation, the spreading of diseases, a decline of biodiversity, and economic losses [1]. In this regard, at the 21st Conference of the Parties held in Paris in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement, as it is known, sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2 °C and to pursue efforts to limit the temperature increase to 1.5 °C.

Following this world trend, the Korean Government plans to reduce the GHG emissions by 37% from the business-as-usual level by 2030 across all economic sectors [2]. Accordingly, policy makers are currently addressing the potential effectiveness of regulations and other measures for reducing the GHG emissions to avoid future climate change impacts and achieve the 2030 mitigation target. To fulfill the reduction goal for GHG emissions, the Korean Government is required to secure sufficient energy sources that emit low levels of carbon.

For this reason the Korean Government recently introduced a renewable portfolio standard that obligates the power generators to supply a portion of electricity from renewable energy sources and has been gradually increasing the portion to decrease the GHG emissions arising from the combustion of fossil fuels. The use of solid refuse fuel (SRF), one of the renewable forms of energy, can contribute to the reduction of GHG emissions. SRF is a solid fuel that consists of biogenic components like paper, cardboard, textiles, and wood. It is also prepared from non-hazardous waste that is utilized for energy recovery rather than landfill and incineration. If SRF can be produced and utilized more than other energy sources, what will be obtained is a decreased demand for landfills and mitigated GHG emissions. In particular, the extensive use of SRF could increase the life expectancy of landfill, because waste that can cause groundwater contamination by leaking pollutants will no longer be buried in landfills. Unlike SRF, when we use fossil fuels for electricity generation and/or heat production, we are faced with a substantial amount of GHG emissions. Thus, SRF is a clean energy source and the most viable alternative to fossil fuels.

However, according to the Korea Environment Corporation [3], only 16% of combustible waste was remanufactured as SRF to support 62 boilers and coal thermal power plants in 2014. Therefore, meeting

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the increasing demand for SRF means that we should augment the remanufacturing ratio. In this respect the Government plans to enhance significantly the ratio of combustible waste that is converted into SRF to about 100% by 2020. This plan is expected to enlarge the number of SRF-making and -using facilities by 4 times by 2020 through remanufacturing the total amount of usable combustible waste as SRF [4].

As a renewable energy source, SRF has additional advantages in Korea. First, it is a considerably cost-effective energy source amongst a number of renewable energies. Korea relies heavily on imports to meet its energy consumption requirements due to the lack of domestic energy resources. Renewable forms of energy have the potential to overcome the gradual depletion of traditional fossil fuels and the environmental impacts associated with fossil fuels while simultaneously solving the issues of energy sustainability. Recently, with the social cost of electrical power reaching astronomical levels, alternative forms of power have become a more appealing option. The considerable advantage of SRF is that it is renewable.

Second, expansion of use of SRF could reduce the fossil fuels imports, when we finally experience the depletion of natural resources such as crude oil, energy produced from non-hazardous waste will be one of the front runners as a viable and renewable source of power. Moreover, expanding its production and use will create jobs and stimulate the economy through the facilities that make and use SRF.

To reap these benefits ensuing from expanding the use of SRF, the Government plans to invest considerable sums of money in SRF research and development and facilities to promote the expansion. Therefore, it has a great interest in assessing the benefits quantitatively to make informed decisions about the investment. There are some studies that measure the benefits of SRF projects in the literature (e.g., see [5–9]). The consumption benefits of electricity or heat produced from SRF can be relatively easily valued. However, assessing the external such as environmental or social benefits of SRF is quite a complicated task, because electricity or heat is traded in the market but the object to be valued concerning the external benefits of SRF is not [10]. Some studies measuring the external or environmental benefits of waste-to-energy are found in the literature (e.g., see [11–16]).

The use of SRF will be rapidly expanded owing to the governmental policy to increase it. For example, the Korean Government is planning to develop a new SRF project for converting discarded combustible wastes as solid fuels and distributing it to power plants that need fuel to generate electricity. Therefore, policymakers demand information on the economic benefits of the SRF for decision-making about whether to implement the SRF project. In order to obtain information on the external benefits of expanding the use of SRF, one would need to measure the willingness to pay (WTP) for the expansion.

The WTP for expanding the use of SRF can be used to decide whether to invest in a new SRF project. Considering constrained public budgets, correct and valid estimates of the economic benefits of the SRF are required to make economically sound investment decisions. The estimates can be beneficially utilized to conduct an economic feasibility study for a new project related to the SRF. Economic evaluation is important because it helps ascertain whether the public favors a proposed SRF project and estimates the degree to which the public is willing to pay for such a benefit.

Therefore, the prime purpose of this paper is to assess the external or environmental benefits of expanding the use of SRF. In the context of economics, the benefits are exactly the same as publics's WTP for the expansion. Our paper attempts to obtain data on the Korean public's WTP for the expansion using the contingent valuation (CV) technique and then to investigate the data by employing the spike model, which can model zero as well as positive WTP data in a univariate setting. The remainder of the paper comprises four sections. The methodology adopted in this study is explained in Section 2. A model of WTP is described in Section 3. The results are reported and discussed in Section 4. The paper is concluded in Section 5.

2. Methodology

2.1. The goods to be valued

The goods to be valued in our study is the external aspect of the governmental plan to enhance the ratio of combustible waste converted into SRF from 16% in 2014 to 100% in 2020 by increasing the number of facilities that make and use SRF fourfold. The expected effects from the plan implementation, which were explained in detail to the respondents in the CV survey using visual aids such as color pictures and tables, are summarized in four points. First, the use of SRF contributes to the abatement of GHG and air pollutant emissions generated from the combustion of fossil fuels. Second, the use of SRF, a domestic energy source, improves the trade balance in that most of the fossil fuels consumed in Korea are imported from abroad. Third, the use of SRF reduces energy dependency and increases the supply security of fuels. Fourth, the SRF facilities stimulate the research and development of less costly production of SRF and create new jobs.

2.2. Method for assessing the public's WTP for expanding the use of SRF

The CV technique has been very widely applied in the literature to obtain the WTP for non-market goods. There are no restrictions on the objects that can be valued using the CV method. In particular, it is more useful than other methods because it can capture the non-use or existence value of goods, which cannot be measured through a market mechanism. Non-market goods include environmental goods or public goods, such as expanding the use of SRF. Thus, as explained earlier, this study seeks to utilize the CV approach to assess the benefits that would result from the policies. It asks randomly chosen the public a question concerning their WTP using a well-structured survey.

Some people may doubt the practicality and usefulness of the CV method because it gathers information from a survey of respondents. In this regard the blue-ribbon National Oceanic and Atmospheric Administration (NOAA) Panel reached the influential conclusion that the CV method can produce reliable quantitative information that can be utilized in decision making for both public administration and judicially, provided that several guidelines proposed by the NOAA Panel are observed [17]. Moreover, following the guidelines can secure the validity and accuracy of the CV method.

2.3. Survey design issues

We commissioned a professional survey firm to arrange the CV field survey. The firm drew a stratified random sample of 1400 households from the national population during October 2015 to obtain information on their WTP for expanding the use of SRF and on their socioeconomic characteristics. The firm, Research Prime Service, Inc., is located in Seoul, the capital of Korea, and has a number of experiences of conducting CV surveys. According to the Korea National Statistical Office, there were 18,705,004 households and fifteen provinces in Korea. In order to draw a random sample of this population, sampling was conducted by the professional polling firm. Our sample of 1400 households was allocated to the provinces in proportion to each province's population characteristics, such as age, income, and gender, resulting in 32 to 342 households being assigned to each province. For example, the numbers of allocated and surveys households in Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, Ulsan, Gyeonggi, Kangwon, Chungbuk, Chungnam, Jeonbuk, Jeonnam, Kyungbuk, and Kyungnam were 321, 109, 74, 81, 46, 48, 27, 342, 36, 32, 45, 48, 32, 71, and 88, respectively.

A CV survey can be conducted using face-to-face in-person, telephone, or mail interviews. The response rate to a mail survey is usually quite low, and a telephone survey can present only a limited volume of information to the respondents. We wished to convey a large